11-24-15

MIL-T-5624N
10 FEBRUARY 1989
SUPERSEDING
MIL-T-5624M
18 AUGUST 1987

MILITARY SPECIFICATION

TURBINE FUEL, AVIATION, GRADES JP-4, JP-5 and JP-5/JP-8 ST

This specification is approved for use by all departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers three grades of aviation fuel (see 6.1).

1.2 Classification. Aviation turbine fuel shall be of the following grades, as specified (see 6.2).

Grade	NATO Code NO.	Description
JP-4	F-40	Wide cut, gasoline type
JP-5	F-44	High flashpoint, kerosene type
JP-5/JP-8 ST		Special test fuel, high flashpoint, kerosene type, for engine development and qualification testing (see 6.1)

1.3 References. General references in other documents to turbine fuels in accordance with this specification with grade not specified shall be interpreted to also include turbine fuels in accordance with MIL-T-83133.

AMSC N/A

FSC 9130

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addresssed to: ASD/ENES, Wright-Patterson AFB OH 45433-6503 by using the self-addressed Standardization Documents Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

THIS DOCUMENT CONTAINS 19 PAGES.

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-I-25017	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric)
MIL-I-27686	Inhibitor, Icing, Fuel System
MIL-T-83133	Turbine Fuel, Aviation, Kerosene Type, Grade JP-8
MIL-I-85470	Inhibitor, Icing, Fuel System, High Flash

STANDARDS

FEDERAL

FED-STD-791	Lubricant, Liquid Fuel and Related Products, Methods of Testing

MILITARY

MIL-STD-290	Packaging of Petroleum and Related Products

QUALIFIED PRODUCTS LIST

QPL-25017	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (Metric)

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Naval Publications & Forms Center, ATTN: NPODS, 5801 Tabor Ave., Philadelphia PA 19120-5099.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment document which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS STANDARDS

ASTM D 86	Petroleum Products, Distillation of
ASTM D 93	Tester, Closed, Flash Point by Pensky-Martens
ASTM D 130	Detection of Copper Corrosion From Petroleum Products By The Copper Strip Tarnish Test
ASTM D 156	Saybolt Color of Petroleum Products
ASTM D 235	Standard Specification For Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 240	Heat of Combustion Of Liquid Hydrocarbon Fuels By Bomb Calorimeter
ASTM D 323	Vapor Pressure of Petroleum Products (Reid Method)
ASTM D 381	Existent Gum In Fuels By Jet Evaporation
ASTM D 445	Kinematic Viscosity of Transparent And Opaque Liquids (And The Calculation of Dynamic Viscosity)
ASTM D 976	Calculated Cetane Index of Distillate Fuels
ASTM D 1094	Water Reaction of Aviation Fuels, Test Method For
ASTM D 1266	Standard Test Method For Sulfur in Petroleum Products, (Lamp Method)
ASTM D 1298	Density, Relative Density (Specific Gravity) Or API Gravity of Crude Petroleum And Liquid Petroleum Products By Hydrometer Method
ASTM D 1319	Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
ASTM D 1322	Smoke Point of Aviation Turbine Fuel
ASTM D 1405	Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D 2276	Particulate Contaminant In Aviation Turbine Fuels
ASTM D 2382	Heat of Combustion of Hydrocarbon Fuels by Bomb Calorimeter (High Precision Method)
ASTM D 2386	Freezing Point of Aviation Fuels, Test Method for
ASTM D 2550	Water Separation Characteristics of Aviation Turbine Fuel
ASTM D 2551	Vapor Pressure of Petroleum Products (Micromethod) Test Method
ASTM D 2622	Sulfur in Petroleum Products by X-Ray Spectrometry
ASTM D 2624	Electrical Conductivity of Aviation and Distillate Fuels Containing A Static Dissipator, Test Method For
ASTM D 2887	Boiling Range Distribution of Petroleum Fractions By Gas Chromatograph, Test Method For
ASTM D 3120	Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcolumetry
ASTM D 3227	Mercaptan Sulfur in Gasoline, Kerosene, Aviation Turbine, and Distillate Fuels
ASTM D 3241	Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT) Procedure) Standard Test Methods For
ASTM D 3242	Acidity In Aviation Turbine Fuels, Test Method For
ASTM D 3338	Estimation of Heat of Combustion of Aviation Fuels, Method For
ASTM D 3343	Estimation of Hydrogen Content of Aviation Fuels
ASTM D 3701	Hydrogen Content of Aviation Turbine Fuels By Low Resolution Nuclear Magnetic Resonance Spectrometry
ASTM D 3703	Peroxide Number of Aviation Turbine Fuels, Test Method For

ASTM D 3948	Method For Determining Water-Separation Characteristics of Aviation Fuel by Portable Separometer
ASTM D 4052	Density and Relative Density of Liquids By Digital Density Meter
ASTM D 4057	Standard Practice For Manual Sampling of Petroleum And Petroleum Products
ASTM D 4176	Free Water and Particulate Contamination in Distillate Fuels (Clear and Bright Pass/Fail Procedures)
ASTM D 4177	Automatic Sampling of Petroleum And Products
ASTM D 4294	Test Method For Sulfur In Petroleum Products by Nondispersive X-Ray Fluorescence Spectrometry
ASTM D 4308	Electrical Conductivity of Liquid Hydrocarbons By Precision Meter
ASTM D 4809	Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Intermediate Precision Method)
ASTM E 29	Recommended Practices For Indicating Which Places Of Figures Are To Be Considered Significant In Specified Limited Values

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19013.)

Department of Transportation

49 CFR 170-189	Department of Transportation Rules and Regulations For the Transportation of Explosive and Dangerous Articles
49 CFR 173-118	Exemption of Flammable Liquids
49 CFR 173-119	Flammable Liquids Not Specifically Provided For

(Application for copies should be addresssed to the Superintendent of Documents, US Government Printing Office, Washington DC 20402.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specification, specification sheets or MS standards), the text of this document will take precedence. Nothing in this document however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Materials. The fuel supplied under this specification shall be refined hydrocarbon distillate fuel oils containing additives in accordance with 3.3 The feed stock from which the fuel is refined shall be crude oils derived from petroleum, tar sands, oil shale or mixtures thereof.

3.2 Chemical and physical requirements. The chemical and physical requirements of the finished fuel shall conform to those listed in Table I or Table II, as applicable.

3.3 Additives. The type and amount of each additive used shall be reported (see 6.3).

TABLE I. Chemical and physical requirements and test methods

Requirements	Grade JP-4	Grade JP-5	Test Method ASTM Standards
Color, Saybolt	Rpt	Rpt	D156
Total acid number, mg KOH/g, max	0.015	0.015	D3242
Aromatics, vol percent, max	25.0	25.0	D1319
Olefins, vol percent, max	5.0	5.0	D1319
Sulfur, Mercaptan, wt %. max. OR	0.002	0.002	D3227
Doctor test	Negative	Negative	D235
Sulfur, total wt, percent, max	0.40	0.40	D1266, D2622, D3120 or D4294
Distillation temperature, deg C (D2887 limits in parentheses)			D86 1/ or D2887
Initial boiling point	Rpt	Rpt	
10 percent recovered, max temp	Rpt	205 (185)	
20 percent recovered, max temp	145 (130)	Rpt	
50 percent recovered, max temp	190 (185)	Rpt	
90 percent recovered, max temp	245 (250)	Rpt	
End point, max temp	270 (320)	300(330)	
Residue, vol %, max (for D86)	1.5	1.5	
Loss, vol %, max (For D86)	1.5	1.5	
Flash point, deg C (deg F), min		60 (140)	D93
Density, at 15°C			D1298 or D4052
kg/L, min (API max)	0.751(57.0)	0.788(48.0)	
kg/L, max (API min)	0.802(45.0)	0.845(36.0)	
Vapor pressure, 37.8°C (100°F) kPa (psi)			D323 or D2551
minimum	14 (2.0)		
maximum	21 (3.0)		
Freezing point, deg C (deg F), max	-58 (-72)	-46 (-51)	D2386
Viscosity, at -20°C, max centistokes		8.5	D445
min centistokes			
Heating value,			
Aniline-gravity product, min, OR	5,250	4,500	D1405
Heat of combustion, MJ/kg, min	42.8	42.6	D2382, D3338 or D4809
or (BTU/lb), min	(18,400)	(18,300)	D240 2/
Calculated Cetane Index		Rpt	D976 3/

TABLE I. Chemical and physical requirements and test methods (Cont'd)

Hydrogen content, wt percent, min	13.5	13.4	D3701 4/
Smoke point, mm, min	20.0	19.0	D1322
Copper strip corrosion, 2 hr at 100°C (212°F), max	1	1	D130
Thermal stability:			
Change in pres. drop, mm of Hg, max	25	25	D3241 5/
Tube deposit code, less than	3	3	
Existent gum, mg/100 mL, max	7.0	7.0	D381
Particulate matter, mg/L, max	1.0	1.0	D2276 6/
Filtration time, minutes, max	10	15 7/	D2276 6/
Water reaction			D1094
Interface rating, max	1b	1b	
Water separation index, min	8/	8/	D2550, D3948
Peroxide number, ppm by wt, max	-	8.0	D3703
Fuel system icing inhibitor			
volume percent min	0.10	0.15	9/.
volume percent max	0.15	0.20	9/
Fuel electrical conductivity, pS/m			
allowable range	150-600 10/		D2624, D4308

1/ A condenser temperature of 0° to 4°C (32° to 40°F) shall be used for the distillation of JP-5 and JP-5/JP-8 ST fuels. For JP-4, group 3 test conditions shall be used. Distillation shall be corrected to 760 mm Hg pressure.

2/ ASTM D3338, for calculating the heat of combustion, is only allowed for use with JP-4 fuel. When the fuel distillation test is performed using ASTM D2877, the average distillation temperature used in ASTM D3338 shall be calculated as follows:

$$V = (10\% + 50\% + 95\%)/3$$

3/ Mid-boiling temperatures may be obtained by either D86 or D2887 to perform the Cetane Index calculation. If D86 values are used, they should be corrected to standard barometric pressure.

4/ ASTM D3343 or ASTM D3701 may be used to measure hydrogen content of JP-4. When measuring hydrogen content of JP-5 and JP-5/JP-8 ST fuel, only ASTM D3701 shall be used.

3.3.1 Antioxidants. Immediately after processing (i.e., during the rundown into feed/batch tank) and before the fuel is exposed to the atmosphere, an approved antioxidant shall be added to all JP-5, and JP-5/JP-8 ST fuels and to JP-4 fuels that contain blending stocks that have been hydrogen treated to prevent the formation of gums and peroxides after manufacture. JP-4 fuels that do not contain hydrogen treated blending stocks may have the antioxidant added at the option of the supplier. The concentration of antioxidant to be added shall be as follows;

a. For JP-5, JP-5/JP-8 ST and hydrogen treated JP-4: Not less than 17.2 mg, nor more than 24 mg of active ingredient per liter of fuel (6.0 to 8.4 lb/1000 barrels).

b. For those JP-4 fuels not hydrogen treated, the supplier may (at his option) add not more than 24.0 mg of active ingredient per liter of fuel (8.4 lb/1,000 barrels).

3.3.1.1 The following antioxidant formulations are approved:

a. 2,6-di-tert-butyl-4-methylphenol

b. 6-tert-butyl-2,4-dimethylphenol

c. 2,6-di-tert-butylphenol

d. 75 percent min-2,6-di-tert-butylphenol
25 percent max tert-butylphenols and tri-tert-butylphenols

e. 72 percent min 6-tert-butyl-2,4-dimethyphenol
28 percent max tert-butyl-methylphenols and tert-butyl-dimethylphenols

3.3.2 Metal deactivator. A metal deactivator, N,N'-disalicylidene-1,2-propanediamine or N,N'-disalicylidene-1,2-cyclohexanediamine may be blended into the fuel in an amount not to exceed two pounds active ingredient per 1,000 barrels of fuel (22 mg/gal (US), 26 mg/gal (UK), or 5.8 mg/liter).

3.3.3 Corrosion inhibitor. A corrosion inhibitor conforming to MIL-I-25017 shall be blended into the JP-4, JP-5 and JP-5/JP-8 ST fuel by the supplier. The amount added shall be equal to or greater than the minimum effective concentration and shall not exceed the maximum allowable concentration listed in the latest revision of QPL-25017. The supplier or transporting agency, or both, shall maintain and upon request shall make available to the Government evidence that the corrosion inhibitors used are equal in every respect to the qualification products listed in QPL-25017.

3.3.4 Fuel system icing inhibitor. The use of a fuel system icing inhibitor shall be mandatory. For JP-4 the icing inhibitor shall be in accordance with MIL-I-27686; for JP-5 and JP-5/JP-8 ST fuel the icing inhibitor shall be in accordance with MIL-I-85470. The point of injection of the additive shall be determined by agreement between the purchase authority and the supplier.

3.3.6 Static dissipator additive. A static dissipator additive shall be added to JP-4 fuels in sufficient concentration to increase the conductivity of the fuel to within the range of 200 to 600 picosiemens per meter at the point of injection. The point of injection shall be determined by agreement between the purchasing authority and the supplier. The following static dissipator additives are approved:

a. ASA-3 marketed by Royal Lubricants Co., Roseland NJ.

b. Stadis 450 marketed by E. I. duPont de Nemours Co., Wilmington DE.

3.4 Workmanship. At the time of government acceptance, the finished fuel shall be visually free from undissolved water, sediment, or suspended matter and shall be clear and bright. In case of dispute, the fuel shall be clear and bright at 21°C (70°F). NOTE: ASTM D 4176 describes a suitable test procedure for determining if fuel is clear and bright.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize the submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as quality conformance inspection (see 4.4).

4.3 Inspection conditions. Requirements contained in table I and table II are absolute and shall not be subject to correction for test tolerances. If multiple determinations are made, results falling within any specified repeatability and reproducibility tolerances may be averaged. For rounding off of significant figures, ASTM E 29 shall apply to all tests required by this specification.

4.4 Quality conformance inspections. Inspection shall be performed in accordance with method 9601 of FED-STD-791.

4.4.1 Inspection lot. For acceptance purposes, individual lots shall be examined as specified herein and subjected to tests for all requirements cited in section 3.

4.4.1.1 Bulk-Lot. A bulk lot shall consist of an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single isolated container.

4.4.1.2 Packaged lot. A packaged lot shall consist of an indefinite number of 55-gallon drums or smaller unit packages of identical size and shape offered for acceptance and filled from the isolated tank containing a homogeneous mixture of material.

4.4.2 Sampling plans

4.4.2.1 Sampling for verification of product quality. Each bulk or packaged lot of material shall be sampled for verification of product quality in accordance with ASTM D 4057 and/or ASTM D 4177, except where individual test procedures contain specific sampling instructions.

4.4.2.2 Sampling for examination of filled containers for delivery. A random sample of filled containers shall be selected from each lot. The samples shall be examined in accordance with 4.5.1.3.

4.5 Inspection methods

4.5.1 Examination of product

4.5.1.1 Visual inspection. Samples selected in accordance with 4.4.1 shall be visually examined for compliance with 3.4.

4.5.1.2 Examination of empty containers. Prior to filling, each empty unit container shall be visually inspected for cleanliness and suitability.

4.5.1.3 Examination of filled containers. Samples, taken as specified in 4.4.2 shall be examined for conformance to MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and markings. Any container having one or more defects under the required fill shall be rejected.

4.5.2 Chemical and physical tests. Tests to determine conformance to the chemical and physical requirements (3.2) shall be conducted in accordance with the applicable test methods listed in table I and those specified herein.

4.5.2.1 Thermal stability. The thermal stability test shall be conducted using ASTM D 3241 (JFTOT). The heater tube shall be rated visually (See Appendix B).

4.5.2.1.1 ASTM D 3241 test conditions.

a. Heater tube temperature at maximum point: 260°C (500°F).

b. Fuel system pressure: 3.45 MPa (500 psig).

c. Fuel flow rate: 3.0 mL/min.

d. Test duration: 150 minutes.

4.5.2.1.2 Acceptability criteria. The fuel sample is acceptable if all the following criteria are met:

a. The maximum visual rating of the heater tube deposits is less than a code 3. (Appendix B, 10.6).

b. The visual rating of the heater tube shows neither peacock type deposit (code P) nor abnormal type deposits (code A) (Appendix B, 10.6.3.1 and 10.6.3.2).

c. The maximum differential pressure across the test filter does not exceed 25 millimeters of mercury.

4.5.2.1.3 ASTM D 3241 reported data

a. Differential pressure in millimeters of mercury at 150 minutes, or time to differential pressure of 25 millimeters of mercury, whichever comes first.

b. Heat tube deposit code rating at the end of the test.

c. If a Mark 8A tube deposit rater is available, the maximum SPUN TDR rating shall be reported for information purposes.

4.6 Test report. Test data required by 4.5.2 shall be reported in the same order as listed in Table I, unless directed otherwise by the procuring activity

5. PACKAGING

5.1 Packaging, packing, and marking. Packaging, packing, and marking shall be in accordance with MIL-STD-290. All fuel containers shall be marked with the actual flash point in degrees F of the fuel contained therein. For JP-4, a flashpoint of -29°C (-20°F) may be assumed.

5.2 Transportation of fuels. The transportation of the JP-4, JP-5 and JP-5/JP-8 ST fuels shall be in accordance with the Department of Transportation Rules and Regulations listed in 2.2.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The JP-4 and JP-5 fuels covered by this specification are intended for use in aircraft turbine engines. The JP-5/JP-8 ST (Special Test) fuel is a worst-case kerosene type aviation turbine fuel in terms of fuel effects on engine starting, altitude relight, combustor durability, and exhaust smoke emissions. This fuel is intended for use in the development, testing, and qualification of engine components, engines, and aircraft. When authorized, the JP-5/JP-8 ST fuel may also be used for qualification testing of ground-based turbine and diesel engines.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2).

c. Grade of fuel required (see 1.2).

d. Quantity required and size containers desired.

e. Level of packaging and packing required (see 5.1).

f. Location and injection method for addition of fuel system icing inhibitor (JP-4, JP-5 and JP-5/JP-8 ST and electrical conductivity additive (JP-4 only).

6.3 Precaution for mixing additives. To prevent any possible reaction between the concentrated forms of different additives (see 3.3), the fuel supplier is cautioned not to commingle additives prior to their addition to the fuels.

6.4 International agreements. Certain provisions of this specification are the subject of international standardization agreement ASCC Air Standard 15/6, ASCC Advisory Publication 15/9, STANAG 1135 and STANAG 3747. When amendment, revision, or cancellation of this specification is proposed which affects or violates the International agreement concerned, the preparing activity shall take appropriate reconciliation action through international standardization channels including departmental standardization office, if required.

6.5 Key words

Fuel

JP-4

JP-5

JP-8

Special test fuel

Turbine

6.6 Units of measure have been converted to the International System of Units (Metric) in accordance with ASTM E 380.

6.7 Greade JP-8 fuel. Characteristics of JP-8 fuel (such as density, distillation temperatures, et cetera) are very similar to those of JP-5. Materials and accessories suitable for use with JP-4, JP-5, and JP-5/JP-8 ST fuel are also suitable for use with JP-8.

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodian:
Army - ME
Navy - AS
Air Force - 11
DLA - PS

Preparing activity:
Air Force - 11

Project 9130-0138

Review activities:

Army - AV, MI
Air Force - 68

APPENDIX A

METHODS FOR DETERMINATION OF FILTRATION TIME AND TOTAL SOLIDS (PARTICULATE)

10. Scope. This method describes a procedure for determining singularly or simultaneously the filterability characteristics and solids contamination of jet fuel. The purpose is to detect and prevent contaminants in jet fuel which can plug and cause rupture of ground filtration equipment, thereby affecting flight reliability/safety of aircraft.

20. Summary of methods. 3.79 liters (one gallon) of jet fuel is filtered through a membrane filter in the laboratory. The time required to filter this volume is measured in minutes and solids content is determined gravimetrically.

30. Apparatus

a. Membrane filter: White, plain 47 mm diameter, nominal pore size 0.8 micron. The membrane must be approved by ASTM for use with ASTM D 2276.

b. Filtration apparatus: Of the types shown in ASTM D 2276, figure A3. It consists of a funnel and funnel base with a filter support such that a membrane filter can be securely locked or clamped between the sealing surfaces of the funnel and its base. The funnel and funnel base shall be of stainless steel or glass construction.

c. Insert ring: The insert ring shall only be used with JP-4 fuel. A 47-mm diameter paper flow reducer ring with dimensions to give filtering area of 4.8 cm^2. (Millipore Corporation Part No. XX10 047 10.)

d. Vacuum flask: A minimum of 4 liters.

e. Vacuum system: That develops in excess of 67.5 kPa (20 inches of mercury) vacuum.

f. Oven: Of the static type (without fan assisted circulation) controlling to $90^{\circ}\pm5^{\circ}C$ ($194^{\circ}\pm9^{\circ}F$).

g. Forceps: Flat-bladed with unserrated nonpointed tips.

h. Solvent filtering dispenser: Containing a 1.2 micron maximum pore size filter in the delivery line.

i. Glass petri dish: Approximately 125 mm in diameter with removable cover.

j. Analytical balance: Single or double pan, the precision standard deviation of which must be 0.07 mg or better.

40. Preparation of apparatus and sample containers. All components of the filtration apparatus (except the vacuum flask), sample containers and their caps must be cleaned as described in A2.6.1.1 through A2.6.1.7 of ASTM D 2276. All metal parts of the filtration apparatus are to be electrically bonded and grounded, including the fuel sample container and the metal insert ring, if used. See ASTM D 2276 for other safety precautions.

50. Sampling. Obtain a representative one gallon sample as directed in A2.7 of ASTM D 2276. When sampling from a flowing stream is not possible, an all level sample or an average sample, in accordance with ASTM D 4057 and/or ASTM D 4177 shall be permitted. The one-gallon sample container shall be an interior epoxy-coated metal can, a brown glass bottle, or a clear glass bottle protected by suitable means from exposure to light.

60. Test procedure

a. Membrane filters shall be removed from the package and placed in an oven for a minimum of 15 minutes at 90°C. After preheating, but prior to weighing, the membrane filters shall be stored in a desiccator.

b. Each membrane filter shall be weighed. A filter weighing in excess of 90 mg will not be used in the test.

c. The insert ring shall be centered on the filter base. The membrane filter shall be placed directly over the insert ring. The top funnel shall be locked into place.

d. Immediately prior to filtering the fuel, shake the sample to obtain a homogenous mix and assure that fuel temperature does not exceed 30°C (86°F). Clean the exterior or top portion of the sample container to insure that no contaminants are introduced. Any free water present in the fuel sample will invalidate the filtration time results by giving an excessive filtration time rating.

e. With the vacuum off, pour approximately 200 ml of fuel into the funnel.

f. Turn vacuum on and record starting time. Continue filtration of the 3.79 liters (one gallon) sample, periodically shaking the sample container to maintain a homogenous mix. Record the vacuum in kPa (inches of mercury) one minute after start and again immediately prior to completion of filtration. Throughout filtration, maintain a sufficient quantity of fuel in the funnel so that the membrane filter is always covered.

g. Report the filtration time in minutes expressed to the nearest whole number. If filtration of the 3.79 liters (one gallon) is not completed within 30 minutes, the test will be stopped and the volume of the fuel filtered will be measured. In these cases, results will be reported as 30+minutes/volume of fuel filtered.

h. Report the vacuum in kPa (inches of mercury) as determined from the average of the two readings taken in 60.f.

i. After recording the filtration time, shut off the vacuum and rinse the sample container with approximately 100 ml of filtered petroleum ether and dispense into the filtration funnel. Turn the vacuum on and filter the 100 ml. rinse. Turn vacuum off and wash the inside of the funnel with approximately 50 ml of filtered petroleum ether. Turn vacuum on and filter. Repeat the funnel rinse with another 50 ml of petroleum ether but allow the rinse to soak the filter for approximately 30 seconds before turning the vacuum on to filter the rinse. With vacuum on, carefully remove the top funnel and rinse the periphery of the membrane filter by directing a gentle stream of petroleum ether from the solvent dispenser from the edge of the membrane toward the center, taking care not to wash contaminants off the filter. Maintain vacuum after final rinse for a few seconds to remove the excess petroleum ether from the filter.

j. Using forceps, carefully remove the membrane filter from the filter base and place in a clean Petri dish. Dry in the oven at 90°C (194°F) for 15 minutes with the cover on the Petri dish slightly ajar. Place dish in a dessicator and allow to cool for a minimum of 15 minutes. If more than one sample is processed, cooling time will have to be increased. Reweigh the filter.

k. Report the total solids content in mg/liter by using the following formula:

$$\frac{\text{Weight gain of filter in mgs}}{3.785} = \text{mg/liter}$$

l. Should the sample exceed the 30-minute filtration time and a portion of the fuel is not filtered, the solids content is mg/liter will be figured as follows: Determine the volume of fuel filtered by subtracting the ml of fuel remaining from 3785.

$$\frac{\text{Weight gain of filter in mgs}}{\text{ml of fuel filtered} \times 0.001} = \text{mg/liter}$$

70. Test limits

a. Filtration time:

(1) The maximum allowable filtration time shall be 10 minutes for Grade JP-4 and 15 minutes for Grade JP-5.

(2) The vacuum should exceed 67.5 kPa (20 inches of mercury) throughout the test (i.e., the differential pressure across the filter should exceed 67.5 kPa (20 inches of mercury)).

(3) The fuel temperature shall be between 18°and 30°C (64° and 86°F). If artificial heat (i.e., a hot water bath) is used to heat the sample, erroneously high filtration times may occur, but this approach is allowed.

b. Total solids: Maximum allowable particulate matter is 1.0 mg/liter.;

80. NOTES:

80.1. If it is desired to determine the filtration time and not the total solids content, perform the test by omitting steps 60.i, 60.j, 60.k, and 60.l.

80.2. If it is desired to determine the total solids content and not the filtration time, use of the insert ring may be omitted. It is also permissible, but not required, to use a control filter for a specific analysis or a series of analyses. When this is accomplished, the procedures specified in A.2 of ASTM D 2276 apply.

APPENDIX B

HEATER TUBE DEPOSIT RATING

10. Visual method

10.1 Snap the upper end of the heater tube into the clamp of the adapter for the heater tube.

10.2 Push the heater tube against the stop of the adapter tube.

10.3 Slide the adapter with the heater tube over the guide rod into the tuberator equipped with a magnifying glass assembly.

10.4 Insert the ASTM color standard into the tuberator.

10.5 Rotate the adapter and position the heater tube so that the side with the maximum deposit is visible.

10.6 Within 30 minutes after completion of the test, visually examine the heater tube in a tuberator. The entire portion of the test section between the bottom shoulder and the top shoulder of the heater tube test section shall be carefully examined using a magnifying glass in conjunction with the tuberator for any signs of discoloration, scratches, or other visually identified defects. When an area of the tube corresponds visually to an ASTM color standard, the color standard code number shall be recorded. If the area being rated has a color between two adjacent color standards, it shall be rated as the lighter (that is lower number) color standards. (NOTE: It is important that all light bulbs in the tuberator are functioning as a change in light intensity can shift the rating significantly. (NOTE: The person rating the tube should have normal ability to distinguish between colors: i.e., the rater should not be color blind.)

10.6.1 In rating the heater tube, the darkest deposits govern and the code number representative of the darkest section, rather than the average deposit, shall be reported.

10.6.2 If a spot or streak is found on the heater tube, it shall be carefully examined under various lighting conditions using a magnifying glass to determine if it is a deposit, a scratch, or tube defect (note that the tube defects should have been found during the pretest inspection of the tube). If the spot or streak is determined to be a scratch or tube defect, it shall be disregarded. If the spot or streak is a deposit, it shall be rated against the ASTM color standards, if larger in area than about 0.025 sq cm (0.004 sq inch); i.e., approximately 1.6 mm x 1.6 mm (1/16 inch x 1/16 inch) square or an equivalent area. However, a streak deposit shall be ignored if less than 0.8 mm (1/32 inch) wide, regardless of length. Note that the tube section is about 3 mm (1/8 inch) in diameter; thus a 1.6 mm (1/16 inch) wide spot is half the diameter of the tube test section and 0.8 mm (1/32 inch) wide streak is one fourth the diameter of the tube test section.

10.6.3 If the heater tube has deposits which do not match the Color Standards, the following criteria shall be used.

10.6.3.1 If the deposit has peacock (rainbow) colors, rate this as code P (P for peacock). If some portion of the deposit does match the Color standards, it shall be rated.

10.6.3.2 Deposits having abnormal colors (for example, blue or gray) shall have a rating of code A (A for abnormal color) assigned.

10.6.3.3 When reporting the overall tube rating, record the rating of the maximum deposit which matches the Color Standards plus P or A if the tube contains deposits which do no match the Color standards. If the tube contains only P or A deposits, just report the appropriate letter (a); do not try to assign a numerical rating to a P or A deposit. Examples of how the rating procedure is to be used are given below:

Example 1: The darkest deposits on the heater tube match Color Standard 3. Also present are peacock colors. Thus, the overall tube rating to be reported is 3P.

Example 2: The heater tube has maximum deposits falling between Color Standards 2 and 3 and has no peacock or abnormal colors. The total tube rating is 2.

Example 3: The heater tube matches Color Standard 1 except for an abnormal deposit which does not match the ASTM Color Standards. The overall tube rating to be reported is 1A.

5/ See 4.5.2.1 for ASTM D3241 test conditions and test limits.

6/ A minimum sample size of one gallon shall be filtered. Filtration time will be determined in accordance with the procedure in Appendix A. The procedure in Appendix A may also be used for the determination of particulate matter as an alternate to ASTM D2276.

7/ The flow reducer ring of Appendix A, 30.c is not required for JP-5 and JP-5/JP-8 ST fuel.

8 The minimum water separation index rating for JP-4 shall be 85 with all additives except corrosion inhibitor/lubricity improver additive and static dissipator additive present or 70 with all additives present except for the static dissipator additive. At the time of manufacture the minimum water separation index (WSIM) rating for JP-5 and JP-5/JP-8 ST fuel shall be 90 with only antioxidant and metal deactivator (if used) additives present, or 85 with all additives except the corrosion inhibitor/lubricity improver present, or 80 with all additives present except the fuel system icing inhibitor present, or 70 with all additives present. Regardless of which minimum the refiner elects to meet, the refiner shall report the WSIM rating on a laboratory handblend of JP-5/JP-8 ST fuel with all additives required by the specification.

9/ Tests shall be performed with method 5327, 5340, or 5342 of FED-STD-791. The refractometer used with Method 5342 has two scales. Use the EGME (ethylene glycol monomethyl ether) scale for JP-4 and the DGME (diethylene glycol monomethyl ether) scale for JP-5.

10/ The conductivity must be in the range of 150 to 600 pS/m at ambient fuel temperature or 29.4°C (85°F), whichever is lower.

TABLE II. Chemical and physical requirements for JP-5/JP-8ST

Requirement	Min	Max	Test Method ASTM Standards
Aromatics, vol percent	23.0	27.0	D1319
Density, at 15°C, kg/L (API)	0.815(42.1)	0.845(36.0)	D1298 or D4052
Hydrogen Content, wt percent	13.3	13.5	D3701
Smoke Point, mm	18.0	21.0	D1322

NOTE: All other requirements of Table I for Grade JP-5 apply.